CLAIMS

What is Claimed is:

1. A fuel cell system comprising:

a fuel cell module including a cathode input responsive to a charge airflow and a cathode exhaust;

a compressor generating the airflow applied to the cathode input of the fuel cell module;

a mass flow meter responsive to the airflow sent to the compressor, and generating a signal indicative of the speed of the airflow through the compressor;

a motor for driving the compressor; and

a controller responsive to the signal from the mass flow meter, said controller providing a signal to the motor to control the speed of the compressor, said controller storing a compressor map of the compressor, said controller determining the discharge pressure and temperature of the compressor from the speed of the compressor and the airflow signal from the mass flow meter, said controller further determining the location on the compressor map at which the system is operating and preventing the compressor from entering a surge condition.

2. The system according to claim 1 wherein the compressor is a turbo-machine compressor.

3. The system according to claim 2 wherein the compressor is selected from the group consisting of centrifugal, radial, axial and mixed flow compressors.

4. The system according to claim 1 further comprising a back pressure valve positioned in the cathode exhaust, said back pressure valve controlling the pressure in the fuel cell module, said controller controlling the orientation of the back pressure valve to prevent the surge condition.

5. The system according to claim 1 further comprising a by-pass valve in the cathode exhaust, said controller controlling the by-pass valve to prevent the surge condition.

6. The system according to claim 1 wherein the fuel cell is on a vehicle or a distributed generation power system.

7. A fuel cell system comprising:

a fuel cell module including a cathode input responsive to a charge airflow and a cathode exhaust;

a compressor generating the airflow applied to the cathode input of the fuel cell module;

a pressure sensor responsive to the airflow from the compressor, said pressure sensor generating a signal of the pressure of the airflow;

a motor that drives the compressor; and

a controller responsive to the signal from the pressure sensor, said controller providing a signal to the motor to control the speed of the compressor, said controller storing a compressor map of the compressor, said controller determining the airflow rate to the compressor from the speed of the compressor and the pressure signal from the pressure sensor, said controller further determining the location on the compressor map at which the system is operating and preventing the compressor from entering a surge condition.

8. The system according to claim 7 wherein the compressor is a turbo-machine compressor.

9. The system according to claim 7 wherein the compressor is selected from the group consisting of centrifugal, radial, axial and mixed flow compressors.

10. The system according to claim 7 further comprising a back pressure valve positioned in the cathode exhaust, said back pressure valve

controlling the pressure in the fuel cell module, said controller controlling the orientation of the back pressure valve to prevent the surge condition.

11. The system according to claim 7 further comprising a by-pass valve in the cathode exhaust, said controller controlling the by-pass valve to prevent the surge condition.

12. The system according to claim 7 wherein the fuel cell is on a vehicle or a distributed generation power system.

13. A fuel cell system comprising:

a fuel cell module including a cathode input responsive to a charge air flow and a cathode exhaust;

a compressor generating the airflow applied to the cathode input of the fuel cell module;

a motor that drives the compressor; and

a controller providing a signal to the motor to control the speed of the compressor, said controller storing a compressor map of the compressor, said controller using the compressor map and the speed of the compressor to prevent the compressor from entering a surge condition.

14. The system according to claim 13 wherein the controller determines the discharge pressure and temperature of the compressor from the speed of the compressor and an airflow through the compressor.

15. The system according to claim 13 wherein the controller determines the airflow rate to the compressor based on a discharge pressure of the compressor.

16. The system according to claim 13 wherein the compressor is a turbo-machine compressor.

17. The system according to claim 13 further comprising a back pressure valve positioned in the cathode exhaust, said back pressure valve controlling the pressure in the fuel cell module, said controller controlling the orientation of the back pressure valve to prevent the surge condition.

18. A method of preventing a surge condition of a compressor in a fuel cell system, said method comprising:

storing a compressor map of the compressor;

driving the compressor at a predetermined; and

using the compressor map and the speed of the compressor to prevent the compressor from entering the surge condition.

19. The method according to claim 18 further comprising measuring the airflow to the compressor and using the compressor map to determine the discharge pressure and temperature of the compressor from the speed of the compressor and the airflow.

20. The method according to claim 18 further comprising measuring the pressure of the discharge airflow from the compressor and using the compressor map to determine the airflow rate to the compressor from the pressure and the speed of the compressor.